

PALAEONTOLOGICAL AND EROSIONAL REVIEW OF BEDROCK EXPOSURES
WITHIN THE PERIPHERY OF THE OLDMAN RIVER RESERVOIR

Report Prepared for Alberta Environmental Protection, Natural
Resources Service Prairie Region, Water Management.

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INTRODUCTION

Paleo-Skullpture Studio Inc. has now completed its study of the bedrock exposures around the Oldman reservoir, including those portions of the Castle, Crowsnest, and Oldman Rivers forming part of the reservoir, as specified in Agreement #97-0208. During the last week of September and the first week of October, 1996, the principle bedrock outcrops were photographed (see photographs 1 - 85), fossils of any kind were sought out, and an attempt was made to assess the extent of erosion.

I have reproduced "FIGURE A1" from the original three-volume Carbex Geological report showing the position of localities 1 to 73 along the Crowsnest, Castle, and Oldman rivers, (completed by Carbex Geological Services Ltd. on December 28, 1987). Of these original localities, we revisited those that lie within the boundary of the reservoir (ie. at or below the reservoir's Full Supply Level of 1118.6m above sea level) and those that are not now under water (see Maps 1-10 and the blueprint included at the back of this report). Just over 50 sites were visited and prospected.

RESULTS IN A NUTSHELL

Fossils are by no means abundant in the Late Cretaceous and Tertiary bedrock exposures around the Oldman River Reservoir. Trace fossils were most often seen, followed by the chalky and fragile remains of mollusc shells, ie. gastropods and bivalves. It was a treat to discover well preserved leaf impressions at three

localities: 1) 33A (Photographs 31-33), 2) to the immediate west of locality 37 (Photographs 39-40), and 3) along the spillway channel, Photograph 81. I did not find any fossilized bone or teeth! Those fossils or rock samples which were collected have been deposited with the Royal Tyrrell Museum in Drumheller, Alberta.

The number on each photograph corresponds to a number on Maps 1-10. The numbers on the photographs in this report do not correspond to the original locality numbers, although at times the photograph number does match the Carbex locality number. For the location of each of the maps within the area of reservoir and right of way, please refer to the blueprint included at the back of this report.

FIGURE 1. Figure 1 is a reproduction of Figure A1 from a report entitled "Paleontological Assessment for the Oldman River Dam Mitigation/Opportunities Plan" completed by Carbex Geological Services Ltd. on December 28, 1987. A large majority of these localities were revisited as part of this palaeontological review, (see also Maps 1-10).

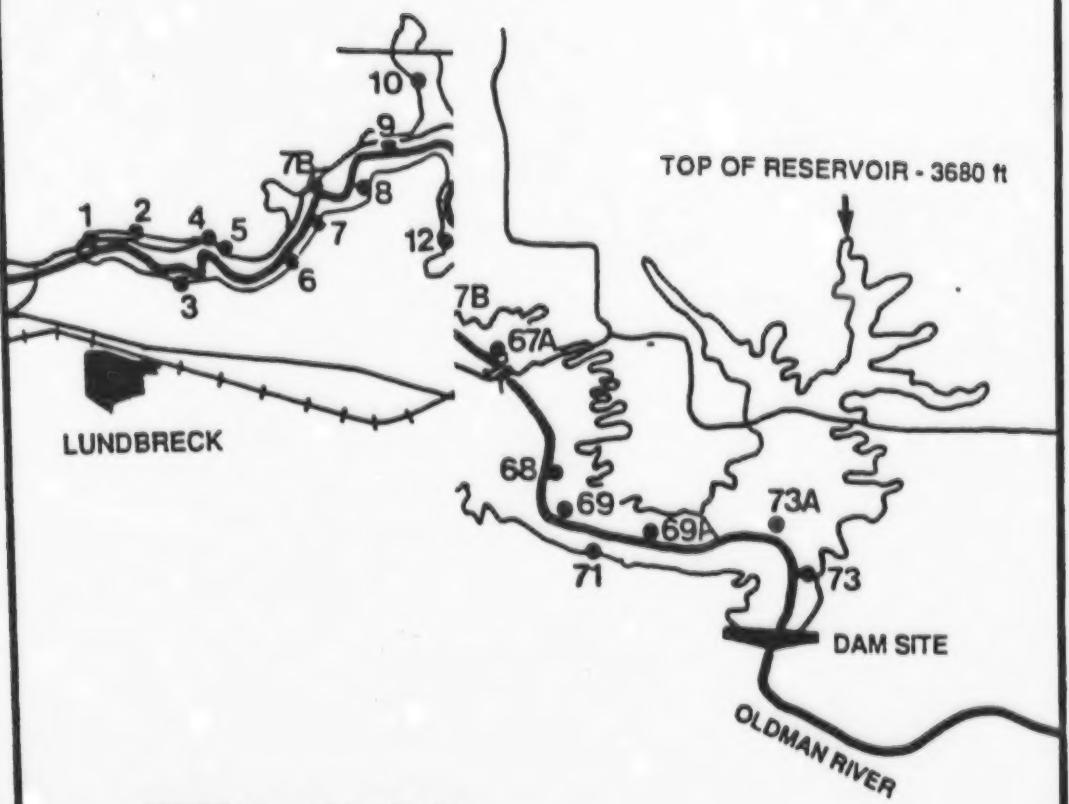


FIGURE A1. Map showing
1 to 73 along the Cr
rivers. All localit
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Scale 1:65000

RESULTS/FINDINGS

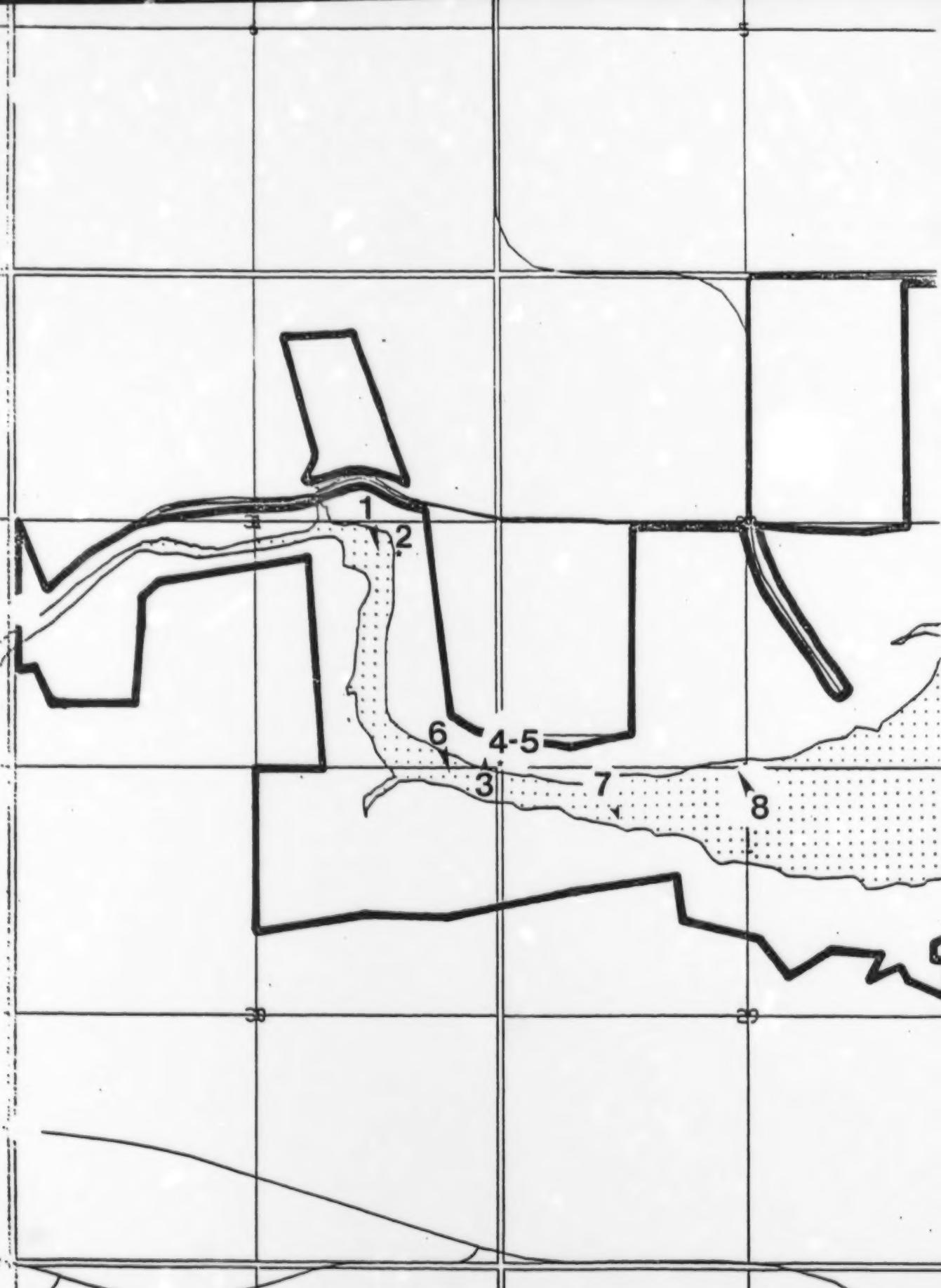
Locality 10: The area which receives Todd and Cow Creeks, no significant change to bedrock exposures. Significant accumulations of mud and silts along the course of this drainage area, main channel had cut down through these fresh mud deposits.

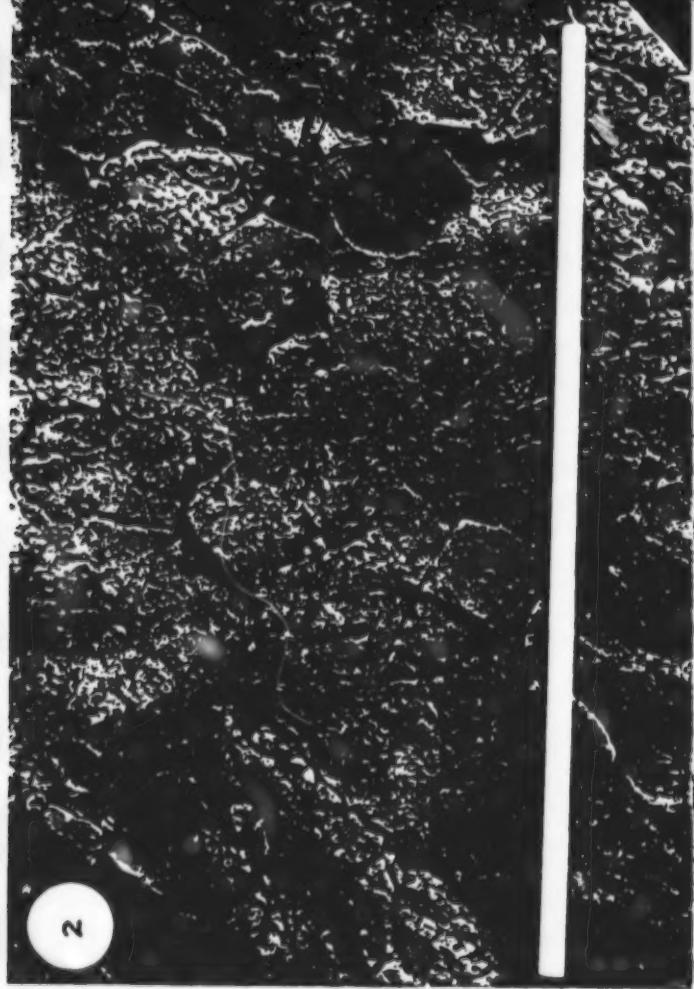
Photograph 1: Looking southward or downstream along the east bank of the Crowsnest River at locality 11. Vegetation covers most of the bank. Massive sandstone blocks from the St. Mary River Formation have broken away and fallen into the river. The base of the tree line, most clearly seen along the left side of the photograph, marks the top of the Full Supply Level, or about 5m above the current level of the water in the river. Sandstone blocks from Unit 4 have broken off and tumbled down the bank into the river. There are numerous trace fossils within the sandstones in this area, as can be seen in Photograph 2. The Pogo stick is 1m. See also Carbex report photographs B26-B28.

Photograph 2: Trace fossils on the surface of one of the massive slumped blocks from Unit 4 at locality 11. The Pogo stick is 1m.

Photograph 3: Looking north at locality 13, showing a massive sandstone unit at the base of the exposure which is now kept plant free as it lies below the Full Supply Level. The paddle is 1.36m long. Note the extensive accumulation of mud and silt in the

MAP 1. The position and direction in which Photographs 1-8 were taken. A small ** indicates where a field specimen (usually an organic or trace fossil) was photographed.





foreground. The indurated sandstone shows little evidence of significant erosion, although there is some slumping of sandstone blocks to form a small scree slope. Erosion appears to be relative minor. There were no plant fossils seen at this locality. Ripple marks and trace fossils were photographed and one trace fossil bearing sandstone block was collected.

Photograph 4: Locality 13, showing burrow-like trace fossils recovered from the scree slope. The lens cap is 56mm in diameter.

Photograph 5: Ripple marks at Locality 13 along the Crowsnest River. The paddle is 15cm wide and 1.36m long.

Photograph 6: Looking southward from locality 13 across the mudflat and the Crowsnest River in the foreground to the 5-6m high beach up to the Full Supply Level. This area typifies many of the low slope tree-lined and north-facing beaches around the Oldman reservoir. Bank erosion is minimal in these areas.

Photograph 7: Looking southward at a section near to where the boundary between the St. Mary River Formation and the Willow Creek Formation passes along the Crowsnest River. Some bank erosion has occurred below the Full Supply Level. Tree stumps, flag stones, and eroded siltstone litter the bank. Erosion minor, some slumping.

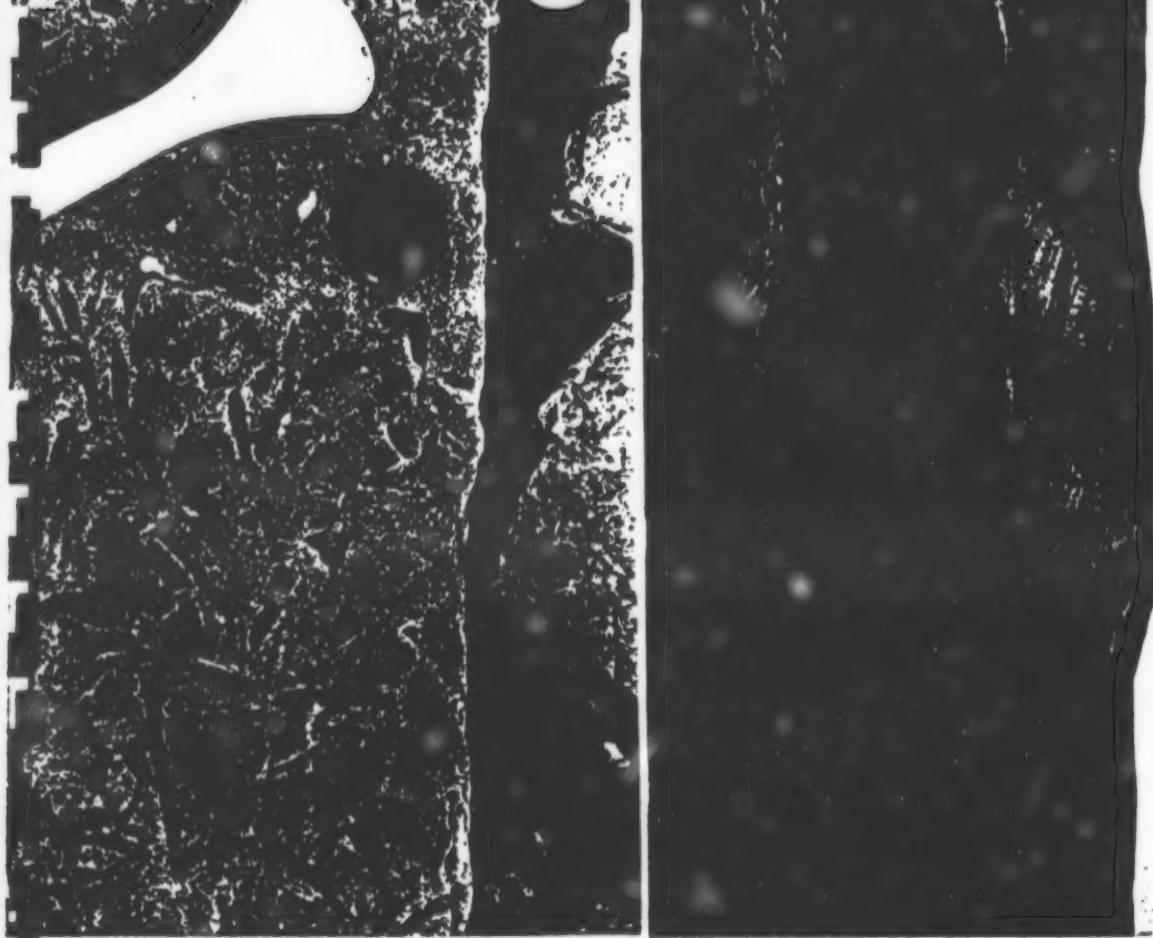


Photograph 8: Faint traces of the eastward dipping ?Willow Creek Formation show through the gently sloping hills on the north side of the reservoir. This is a typical treeless south-facing slope. A vertical height of almost 8m separates the water level from the top of the Full Supply Level. The Full Supply Level at 1118.6m is marked by a conspicuous horizontal line across this hill below which plants are few. From this point over to Locality 17, there are no significant sections exposed and erosion is minimal to nil.

Photograph 9: View of much of the upper portion of locality 16. The basal cross-bedded sandstone, about 4m above the water level corresponds to unit 8 in the original Carbex report. This horizon is showing significant signs of erosion with large sandstone blocks tumbling down into the water. These sandstone blocks slump as water erodes the soft shales below unit 8. The top of the grey water-washed sandstone marks the Full Supply Level. At the top of this section, immediately below the prominent sandstones of units 15 and 16, the multi-coloured shales are very soft and easily eroded. Compare Carbex report photographs B33-B37.

Photograph 10: Trace fossils in a coarse sandstone at locality 16. The lens cap is 56mm in diameter.. No invertebrate, vertebrate, or plant fossils were recovered from this locality.

Photograph 11: Looking west, out over the west end of the Oldman reservoir. Locality 16 lies hidden around the point on the left



MAP 2. The position and direction in which Photographs 9-19 were taken. A small ** indicates where a field specimen (usually an organic or trace fossil) was photographed.



side of the photograph (Photographs 13 and 14 were taken from this area). The Crowsnest River enters the main body of the reservoir at the centre of the photograph. Next to Photograph 12, they provide a panoramic view of the west end of the reservoir.

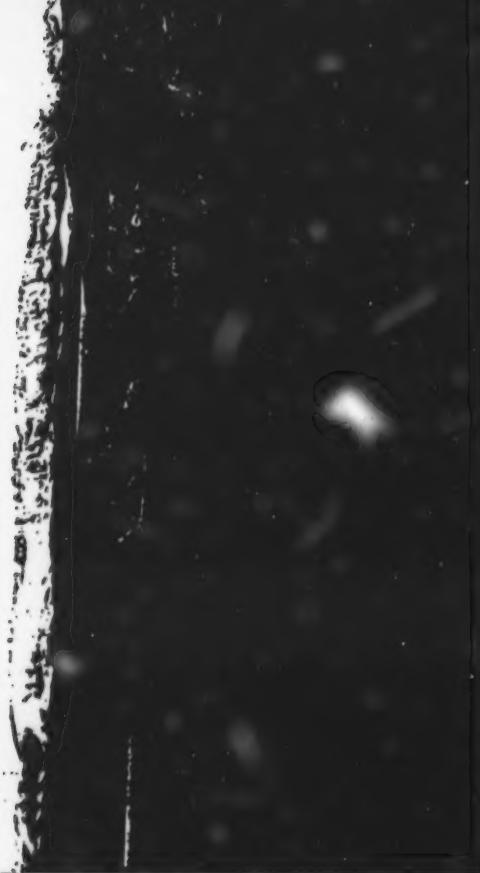
Photograph 12: Looking to the northwest at a lengthy horseshoe-shaped section of the Willow Creek Formation. These exposures includes localities 17 - 19.

Photograph 13: Looking north across the reservoir at the section seen in Photograph 12. Photographs 13 and 14 provide a panoramic view of this section within the Willow Creek Formation. To the centre-left of this photograph, immediately around the point, lies the Cowley Tyrannosaurus rex quarry. Photographs 13 and 14 were taken from the concrete road surface (elevation 1112m) on the south side of the reservoir adjacent to locality 16.

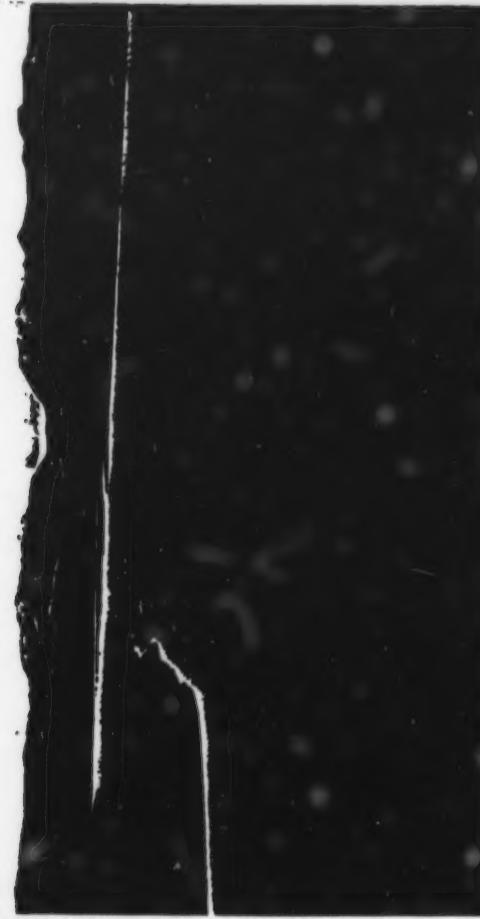
Photograph 14: Looking to the northeast at a section of the Willow Creek Formation. Photographs 13 and 14 were taken from the concrete road surface (elevation 1112m) on the south side of the reservoir adjacent to locality 16.

Photograph 15: This section of newly exposed strata occupies the centre of Photograph 13. Rotate photograph 15, 90 degrees to the left in order to view it in its correct orientation. This small section lies below the Full Supply Level. Although it is beyond

(12)



(14)



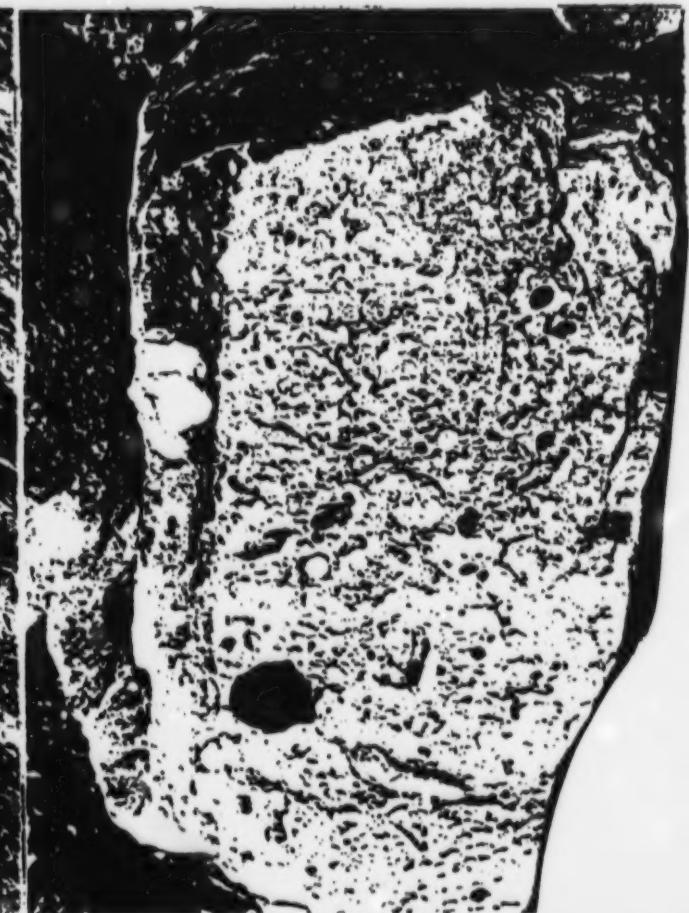
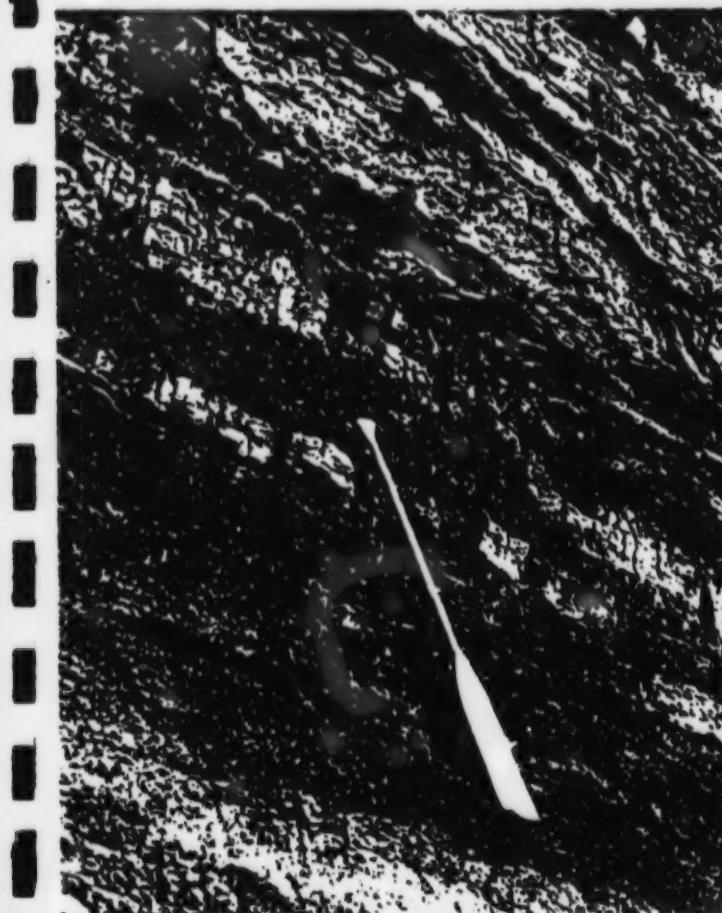
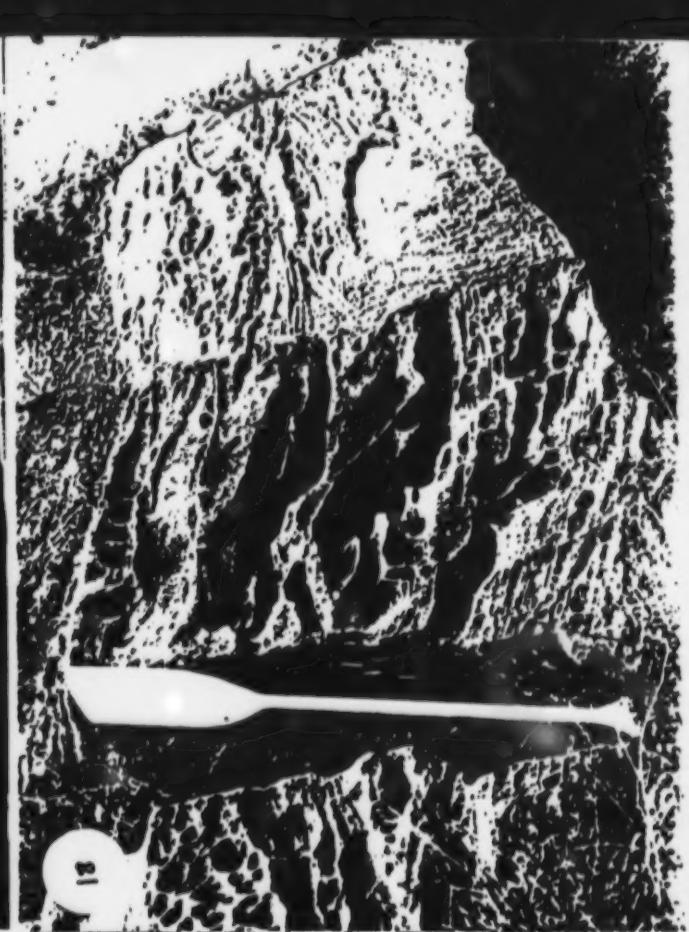
the scope of this report to quantify the amount of sediment being eroded annually, I suspect that it is not an insignificant amount. The water logged shales disintegrate rapidly. Little eroded sediment is able to accumulate on this nearly vertical face. The paddle is 1.36m long. If vertebrate bone were to be present in these sediments, it would be very difficult to recognize in this very angular and rapidly eroding exposure.

Photograph 16: Looking east along localities 17 - 19. The water-washed units are more clearly defined. Note how the sandstones become more prominent as the softer shales are eroded out from above and below. See also Carbex report photographs B39-B44.

Photograph 17: Sandstone block from locality 18 riddled with infilled burrows and other trace fossils. Lens cap is 56mm in diameter. A partial oyster shell was recovered from this locality. However, this fossil was not in situ.

Photograph 18: Honey-combed cross-bedded sandstone of the Willow Creek Formation at locality 19. The paddle is 1.36m long.

Photograph 19: Looking south at an eastward dipping exposure near the contact between the Willow Creek Formation and the Porcupine Hills Formation. The position of this contact is not known. This photograph was taken to the immediate west of locality 22. Although many units are exposed, the beach is littered with tree



stumps, Pleistocene till, and eroded Cretaceous sediments. These eroded sediments now form multiple "beach" levels, recording the seasonal drops in reservoir water level. The living trees and green ground cover lie approximately 8m above the current water level. High spire gastropods were recovered from a 10cm thick silt- or mudstone unit. The shells are exceedingly delicate and disintegrate as quickly as do the sediments.

Photograph 20: Looking southeast at or very near locality 22, and to the east of photograph 19. The description of this area is much the same as in the previous photograph. The exposed sedimentary rocks of the Willow Creek Formation or Porcupine Hills Formation are riddled with fractures. These sediments break into angular pebble- to cobble-sized chunks.

Photograph 21: This dark fine-grained mudstone lies within the area of locality 22. The fossilized remains of gastropods are common in this unit. In this photo they appear as the white flecks within the darker mudstone. These water-washed sediments are highly fractured and crumble easily. The lens cap is 56mm in diameter.

Photograph 22: Half way between locality 29 and 30. This section along the Oldman River is approximately at the Full Supply Level for the reservoir. Up river from this point, there had been virtually no change in the outcrops from the initial Carbex

20



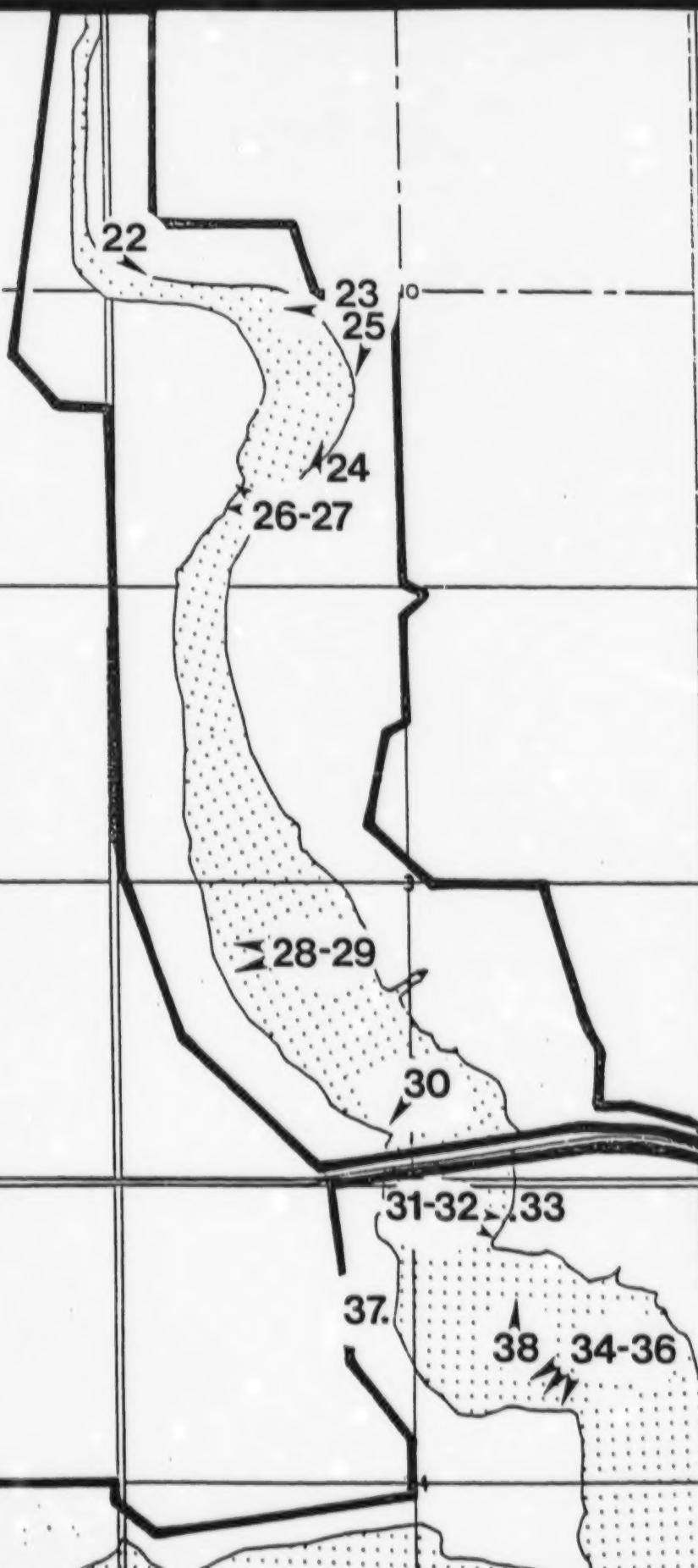
22



MAP 3. The position and direction in which Photographs 20-38 were taken. A small ** indicates where a field specimen (usually an organic or trace fossil) was photographed.

Tp. 8

S 1/2 1
NE 2 & SE 11
S 1/2 2, S 1/2 3, & S 1/2 4
W 1/2 3 & SW 10
N 1/2 3
S 1/2 3
N 1/2 3 & SE 3
3-1/2-3
E 1/2 9 & SW 10
NW 10
NW 10
SE 11
SE 16



geological report. This shear face of indurated sandstone has experienced little apparent erosion. Photograph 23 was taken from locality 30, which is the large section seen in the left one third of this photograph.

Photograph 23: Looking westward and upriver from locality 30 back towards where photograph 22 was taken (centre left). Wide, cobble strewn mudflats characterize these upper reaches of the reservoir.

Photograph 24: Looking north and up the Oldman River from locality 31 at locality 30. I did not find one scrap of bone or petrified wood in this very large exposure of the Porcupine Hills Formation. Needle in a haystack comes to mind. There were a few and I mean few trace fossils. There has been little change in this slope since the initial Carbex report (refer to Carbex photograph C4). The Full Supply Level is marked by the horizontal line along the "beach" below which plants do not occur. Below the Full Supply Level, loose sediments are removed from the outside bank leaving the larger sandstone blocks in place. The cliff face is approximately 100 m high. See also Carbex report photograph C4.

Photograph 25: Looking southward and down river from locality 30 at locality 31. This large section is a continuation of the exposure seen at locality 30. The description of locality 30 would apply equally well to this site. Note the very large mudflat which is flooded at Full Supply Level.

24



Photograph 26: Looking west at the west end of locality 32. Some of this area can be seen in Carbex photograph C3. The softer mudstones and carbonaceous shales are eroding and tumbling down the beach to form multiple mudstone "beach" levels. There are relatively minor accumulations of sandstone flagstones on the beach. No organic or trace fossils were found at this site.

Photograph 27: Looking in a north-westerly direction at locality 32. This area lies at the centre of Carbex photograph C3. This highly contorted sandstone has resisted the effects of erosion well.

Photographs 28 and 29: Looking west at locality 34. These photographs give a panoramic view of this locality. The Carbex study reported that the exposures in this area were poor. Erosion has rectified this problem. Although the sandstones appear to resist well, the intervening fine-grained sediments are much more quickly removed. A few trace fossils were observed at this site. Carbonaceous debris is present in the sandstones.

Photograph 30: Looking west, to the southeast of photograph 28, at a relatively small outcropping of the Porcupine Hills Formation along the Oldman River. This site lies on the first point immediately north of the bridge on the west bank. There is limited erosion in this area. Some sandstone blocks are slumping. A thin veneer of displaced muddy sediments cover much of the exposure.



MAP 3. The position and direction in which Photographs 20-38 were taken. A small "*" indicates where a field specimen (usually an organic or trace fossil) was photographed.

S 1/2 1
NE 2 & SE 11
S 1/2 2, S 1/2 3, & S 1/2 4
W 1/2 3 & SW 10
N 1/2 3
S 1/2 3
N 1/2 3 & SE 3
S 1/2 3
E 1/2 9 & SW 10
NW 10
NW 10
SE 11
SE 16

22

23

25

24

26-27

28-29

30

31-32

33

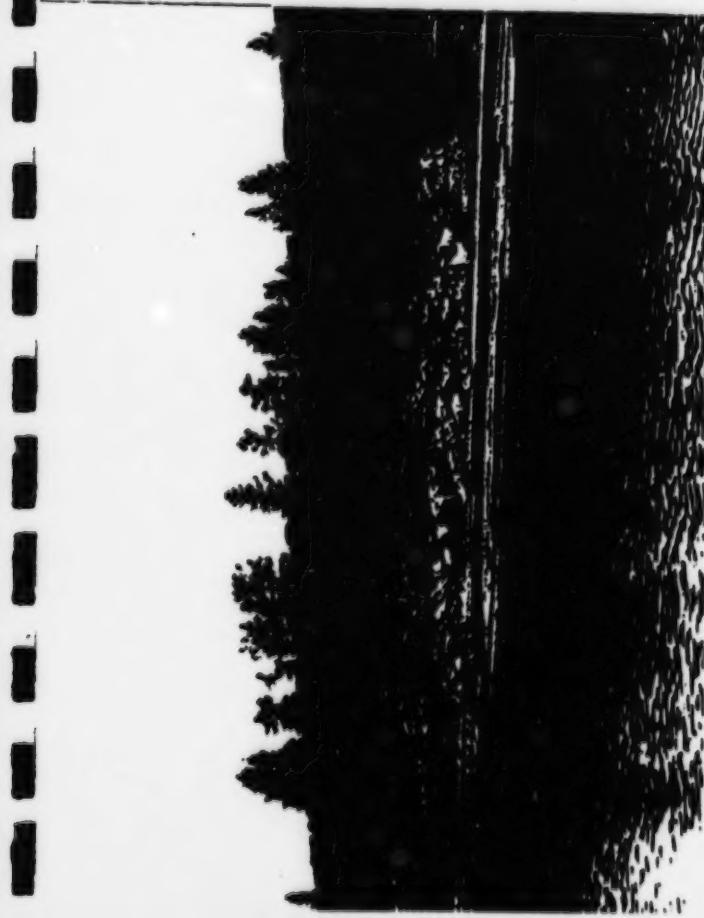
37.

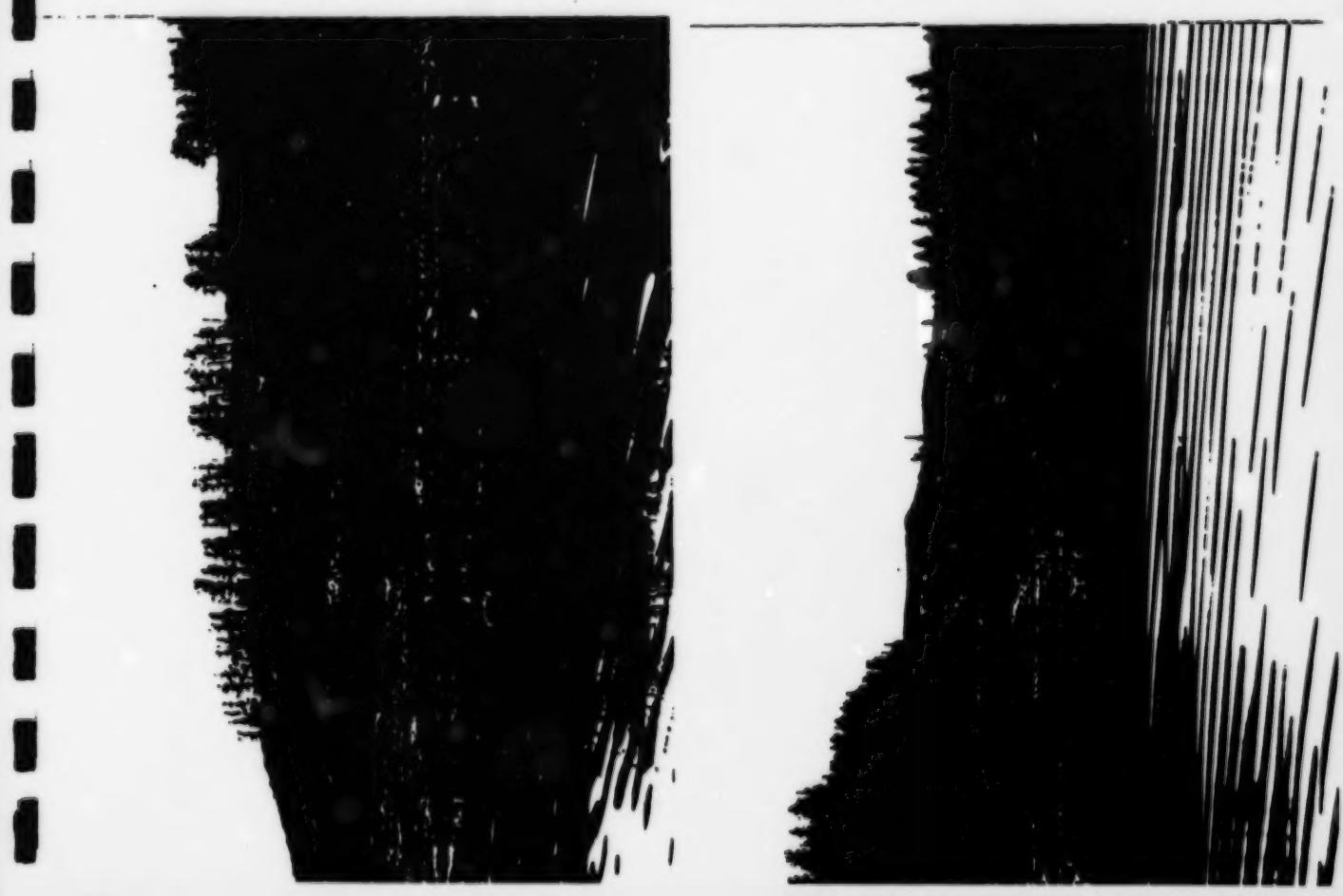
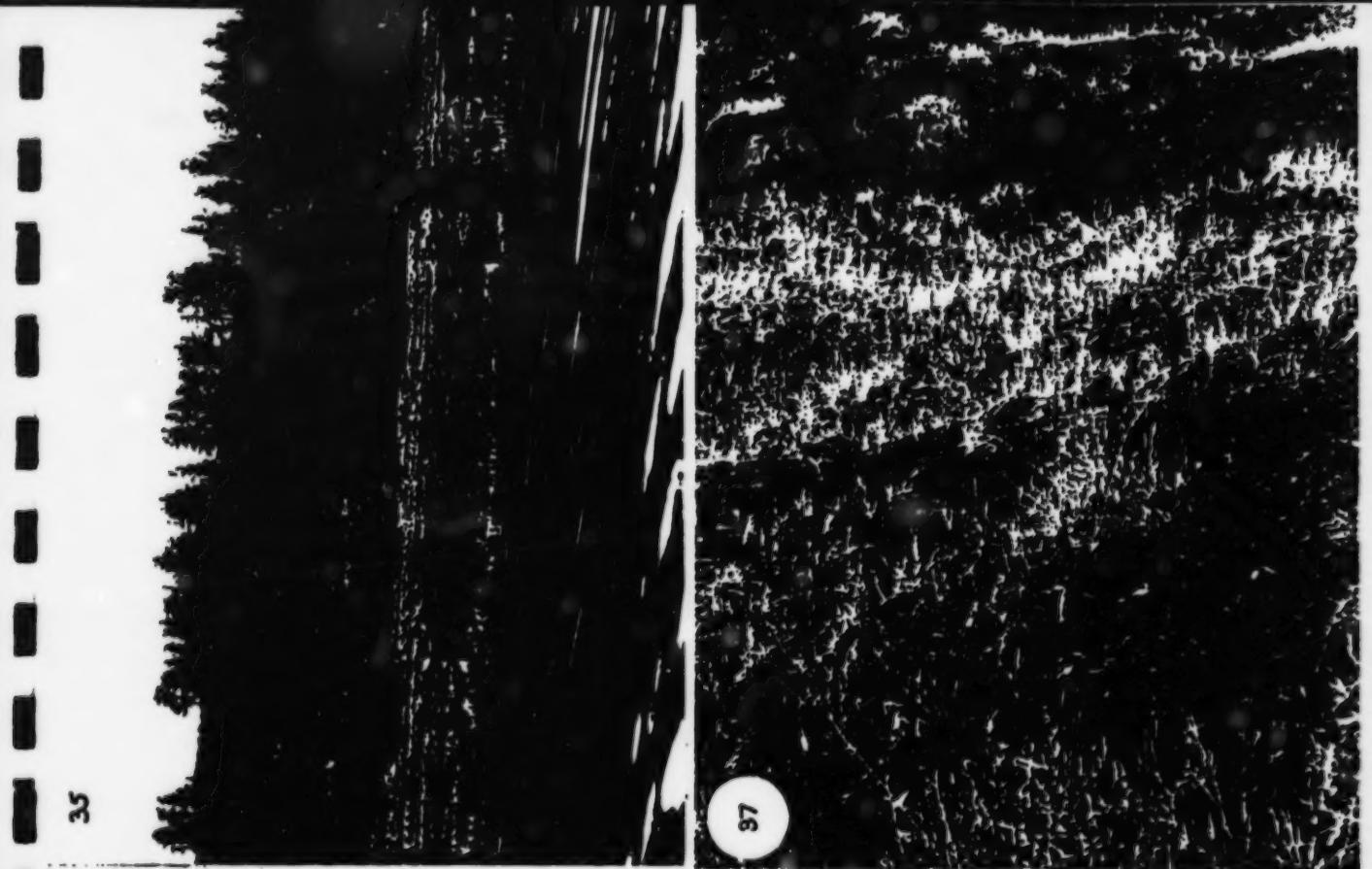
38 34-36

Photographs 31 and 32: These photographs offer a panoramic view of locality 33A. The Full Supply Level is clearly marked by the horizontal line along the lower one third of the outcrop. The sediments within this lower third are those of the Porcupine Hills Formation. The dipping strata of the Porcupine Hills Formation are overlain unconformably by Pleistocene tills which occupy the upper two thirds of the section. The appearance of the bank and its constituent sediments would appear to indicate that erosion is more rapid here than at many other sites. In spite of the extremely friable nature of the fine-grained sediments, well preserved carbon film leaf impressions were discovered at this locality (see photograph 33). They lie near the sandstone lens seen in Photograph 31. The leaf impressions occur in fine-grained siltstones 1 - 2m above the 1110.96m water level. For much of the year, this site is below water level. This site, when not flooded, is accessible from the east side of the bridge.

Photograph 33: Fossilized broad leaf and conifer needles recovered from locality 33A. The fossilized plant remains appear to be very localized, but common at this site. A number of samples were collected. The lens cap is 56mm in diameter.

Photographs 34, 35, and 36: These three photographs provide a panoramic view of locality 35, a site very near to where the Oldman River valley opens out into the main body of the reservoir. Photograph 34 views the locality from the north. Photograph 35 was





taken to the northeast of the locality, whereas photograph 36 views the west end of the section from the east. Most of the Tertiary, Porcupine Hills Formation is now under water; compare with Carbex photographs C6 - C9. All Porcupine Hills Formation strata at this locality lie below the Full Supply Level. Below the Full Supply Level, the beach is littered with washed Pleistocene glacial cobbles. Collapse of the unconsolidated sediments in this area appears to be significant. Note that the dipping Porcupine Hills Formation is overlain unconformably by a great thickness of Pleistocene tills.

Photograph 37: To the immediate north or right of Photograph 36, there is a major slump of Pleistocene soil and till. The rate at which this slump is moving is unknown. It would appear that this slide will continue to move into the reservoir.

Photograph 38: Looking north from the position where Photographs 34 - 36 were taken one will see the gentle slope of this non-eroding bank north of locality 36. To the far left, one can see in the distance the protective riprap along the approach to the bridge. Locality 33A lies on the north side of the point seen to the left.

Photograph 39: This newly exposed section lies to the immediate west of locality 37. The strata now exposed below the Full Supply Level, marked by the horizontal line immediately below the tree

line, were not exposed at the time of the Carbex geological study. This area was covered by a stand of Douglas Fir. The more or less in situ stumps support this claim (see photograph 40). It is fairly typical of north-facing exposures. The beach is covered with stumps and tree trunks, multiple mushy muddy "beach" levels and Pleistocene tills. All but the most prominent sandstones of these Tertiary strata are poorly exposed. The exposed sedimentary strata are highly fractured and easily excavated. Water-washed sediments are smeared over much of the section. As the softer sediments are removed from below the massive sandstones, large blocks of the latter then tumble down the bank. Immediately above the current water level of 1110.96m, in the centre of the photograph is an area shown in more detail in Photograph 40. Well-preserved broad leaf impressions were recovered from this site.

Photograph 40: View of the existing beach near locality 37. The dark mudstone immediately above the water level in the centre of the photograph preserves beautiful carbon-film impressions of relatively large leaves. The productive site appears to be very small and all leaf impressions were collected. Like the leaf impression site at locality 33A, this one would lie below water level for most of the year. The roots of the Douglas Fir stumps in this photograph have become exposed as the relatively soft tertiary sediments of the Porcupine Hills Formation are eroded and washed into the reservoir. The degree to which the roots of these stumps have become exposed might give a rough estimate of the rate of

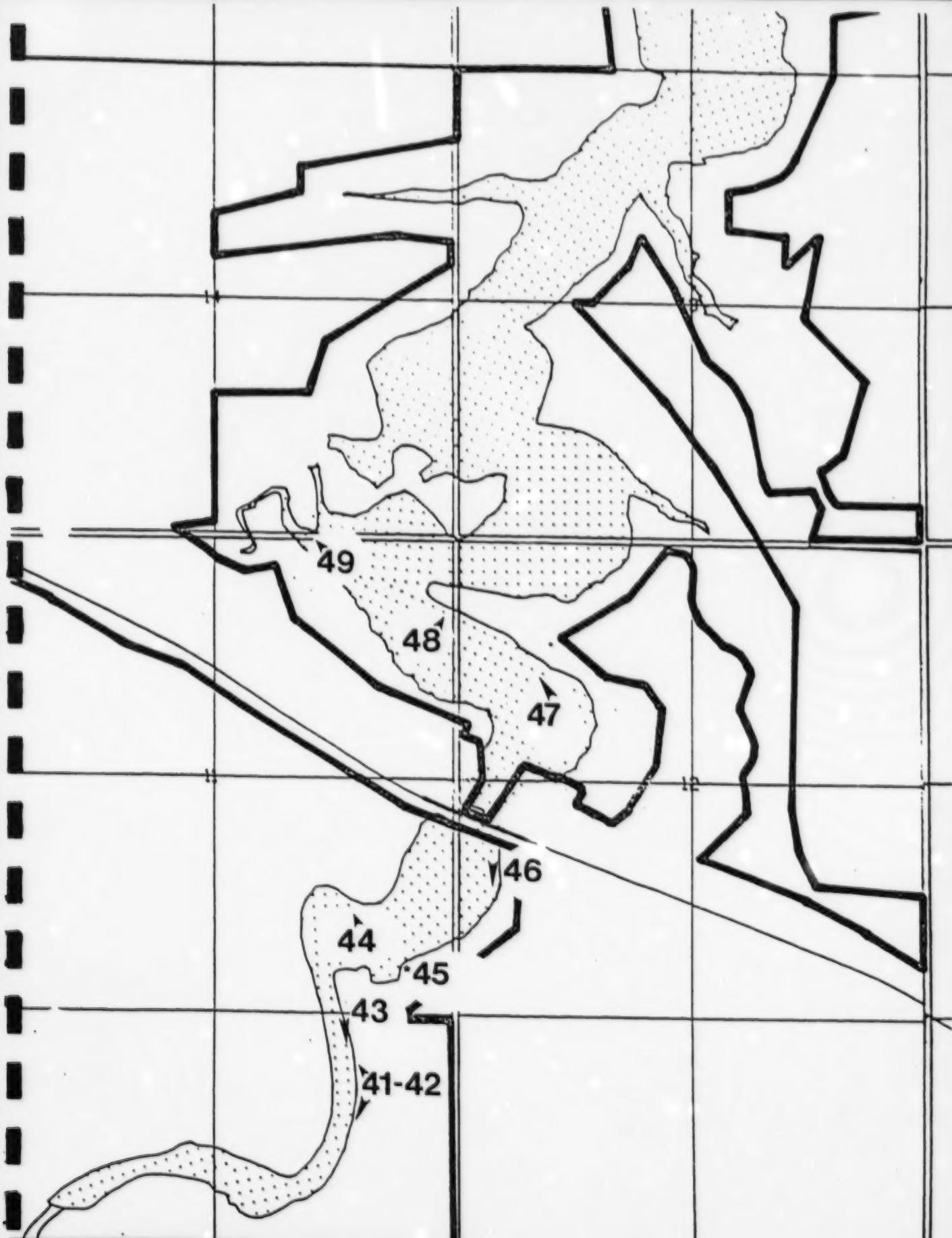
MAP 4. The position and direction in which Photographs 39-40 were taken. A small "*" indicates where a field specimen (usually an organic or trace fossil) was photographed.



39



MAP 5. The position and direction in which Photographs 41-49 were taken. A small ** indicates where a field specimen (usually an organic or trace fossil) was photographed.



erosion in this area of the reservoir.

Photograph 41: Looking southward from the top of locality 43 at a large section of Cretaceous Willow Creek Formation strata, overlain unconformably by a great thickness of Pleistocene tills. The thickness of Pleistocene tills at this locality is approximately equal to the thickness of Cretaceous strata. Much of this section along the Castle River is inaccessible. No fossils were seen at this site. This photograph was taken from the edge of a huge slump of Pleistocene tills more clearly seen in the following photograph.

Photograph 42: Looking to the northwest and down at a massive slump of mostly Pleistocene tills at locality 43. Fissures or crevasses up to 1m in width mark the upper surface of this slump and run more or less parallel to the rivers edge. Individual with 1m long Pogo stick at centre left for scale. Some of this slump has already collapsed into the Castle River as seen in the following photograph.

Photograph 43: Taken at the north end of locality 43, looking south along the exposure of Willow Creek Formation strata which are overlain unconformably by Pleistocene tills. Some of the collapsing Pleistocene tills can be seen in the centre of this photograph to have spilled down into the Castle River. Above this slump was where Photographs 41 and 42 were taken. No fossils were found along this stretch of the river. See also Carbex report



photographs B47-B48.

Photograph 44: Looking in a northwesterly direction at locality 46. The thick sandstone unit (unit 2 in the Carbex report) apparently of the Porcupine Hills Formation with a slight eastward dip would appear to have changed little in the past nine years, (see Carbex photograph B55, taken to the south of this locality).

Photograph 45: Along the southwest end of locality 47, Pleistocene tills at about the Full Supply Level are slumping down into the Castle River. I would not judge this erosional area to be one of major concern. The Pogo stick is 1m long.

Photograph 46: Looking south along locality 47. Most of the outcrop is littered with mud and Pleistocene cobbles. Some Cretaceous Willow Creek Formation sandstones have found their way onto the scree slope. The very angular nature of the fractures in the sedimentary units seen to the left evidence fairly recent exposure. Note once again how the dropping water levels have worked the silts into multiple "beach" levels. Erosion could be rapid along this curved stretch of the Castle River. The photograph was taken at the Full Supply Level, which is seen as a horizontal line running through the centre of the photograph. No in situ fossils of any kind were found at this locality. These Willow Creek Formation strata are overlain unconformably by Pleistocene tills.

Photograph 47: Looking in a northwesterly direction along a lengthy exposure of Porcupine Hills Formation sediments. Carbonaceous debris was noted in some of the sandstones. No other fossilized remains were seen. I would not want to suggest that erosion is occurring at a rapid rate at this locality even though there were some massive sandstone blocks which had tumbled down onto the beach as seen in Photograph 48. Photograph 48 was taken at the west end of this exposure. See also Carbex report photograph C42.

Photograph 48: Looking in a northeasterly direction at the west end of locality 48. Sandstone blocks both large and small derived from units 3 and 4 of the Porcupine Hills Formation, litter the beach, as do other softer eroded sediments. They cover most of the interbedded shale, sandstone and siltstones of unit 2. The Pogo stick is 1m long. The Full Supply Level lies about 7m above the current water level at the base of unit 3.

Photograph 49: Looking in a northwesterly direction at a sandstone unit within the Porcupine Hills Formation along the Castle River. Both the beach and sandstone exhibit little evidence of significant erosion.

Photographs 50 and 51: These two photographs offer a panoramic view of locality 50 (see also Carbex report photograph C48). Although this section is shear, the prominent sandstone units



MAP 6. The position and direction in which Photographs 50-62 were taken. A small ** indicates where a field specimen (usually an organic or trace fossil) was photographed.

NE 22,
NE 23
E 1/2 2
NW 24
E 1/2 2
SW 27
FR. S
N 1/2 3
FR. N
N 1/2 3
SE 34
NE 35



appear to have kept this exposure relatively intact. The Pogo is 1m long.

Photograph 52: This section of Porcupine Hills Formation lies to the immediate east of section 50. This outcrop is being viewed from the southwest. Clam (?unionid) shells are present in the sandstone (Photograph 53). The Pogo stick is 1m long. To the east of this photograph, there is some minor slumping of soil and turf.

Photograph 53: Clam shells (?unionids) are present in one of the sandstone units at this locality. I was unable to determine the unit from which they were derived. The one dollar coin is 26mm in diameter.

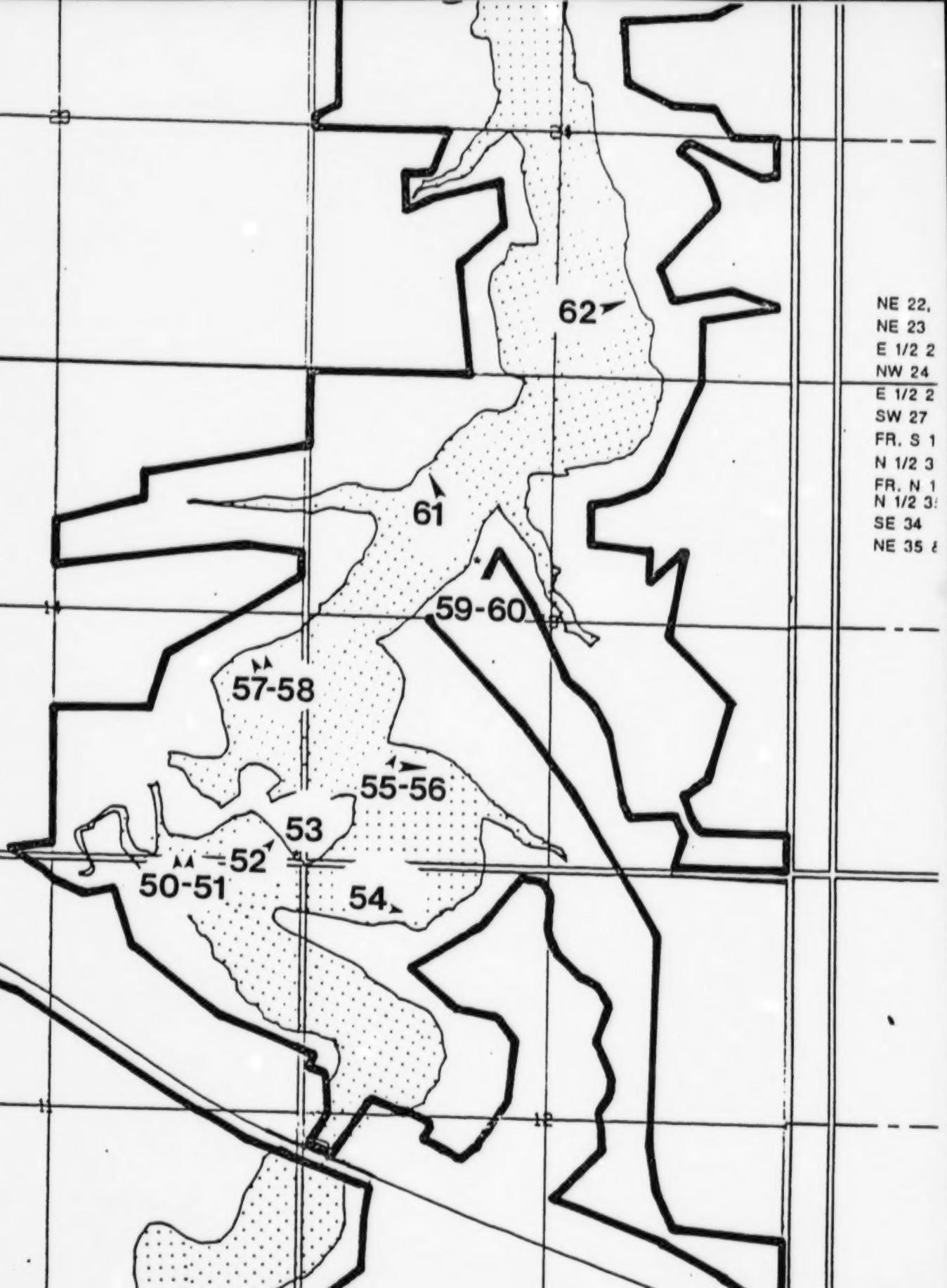
Locality 49: Although there are good outcroppings here, no fossils were found at this locality along the Castle River. The section is sheer with minor slumping and multiple level "beaches".

Photograph 54: Was taken to the immediate east of locality 49, showing a section of the Porcupine Hills Formation. Looking eastward towards locality 51. Estimated rate of erosion; light to moderate.

Photographs 55 and 56: Looking northeast and east, these two photographs provide a good panoramic view of locality 52 and the Castle River. Trace marking and carbonaceous debris were observed



MAP 6. The position and direction in which Photographs 50-62 were taken. A small "*" indicates where a field specimen (usually an organic or trace fossil) was photographed.



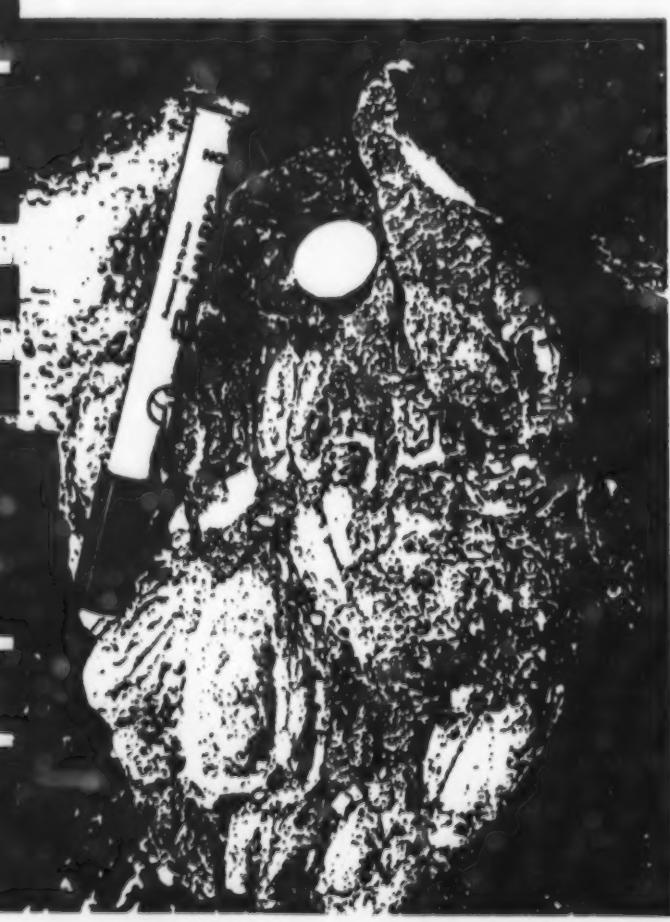
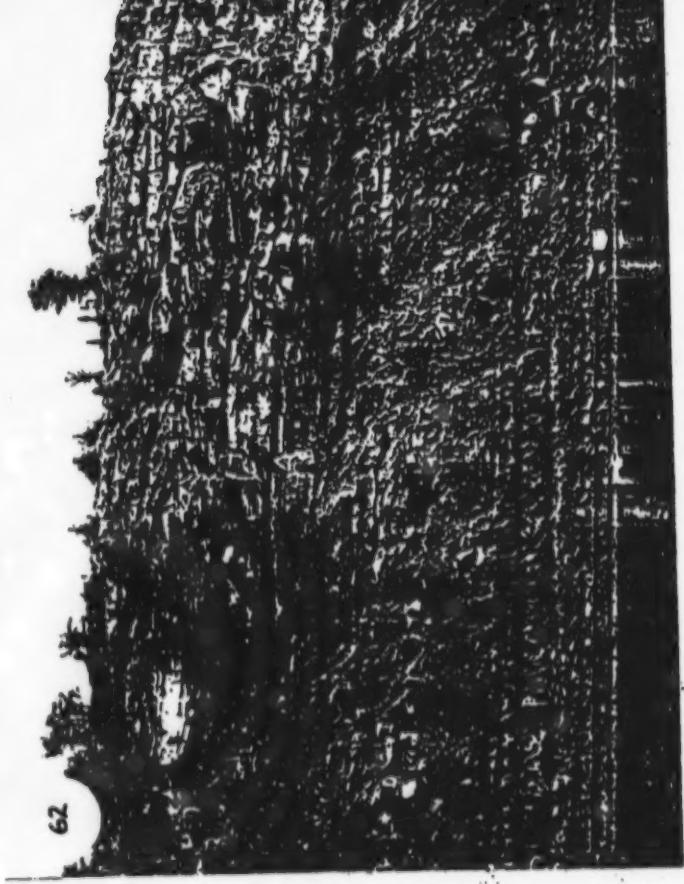


in the sandstones along the west end of the section. I would characterize the fossiliferous resource at this site as stark. The degree to which the prominent sandstone units have been undercut and the number of these blocks on the scree slope would indicate to me that erosion is substantial at this locality. Most of the lower portion of the beach is littered or covered with eroded sediments.

Photographs 57 and 58: Looking northwest and north respectively at or between localities 53 and 53B. This section is fairly clean. The prominent and massive sandstones appear to have resisted erosion well. Clam shells derived from units 11 or 12 were collected from this locality. The sample also contained a small section of carbonized wood. The Pogo stick is 1m long.

Photograph 59: These clam shells (?unionids) were recovered in situ from a unit within the Porcupine Hills Formation very near to, if not at locality 54. The one dollar coin is 26mm in diameter and the marker is 16cm in length. The unit lies 1m below the Pleistocene tills approximately 100m north of the old train bridge and preserves bivalves and gastropods. There are fairly good exposures at this locality, except for the ubiquitous presence of mud and silt multiple "beach" levels below the Full Supply Level. Only minor slumping.

Photograph 60: Trace fossils of the type noted in the Carbex report (Photograph C62) were photographed at locality 54. The



MAP 7. The position and direction in which Photographs 63-67 were taken. A small "*" indicates where a field specimen (usually an organic or trace fossil) was photographed.

SE 11

510

66

65

64

67

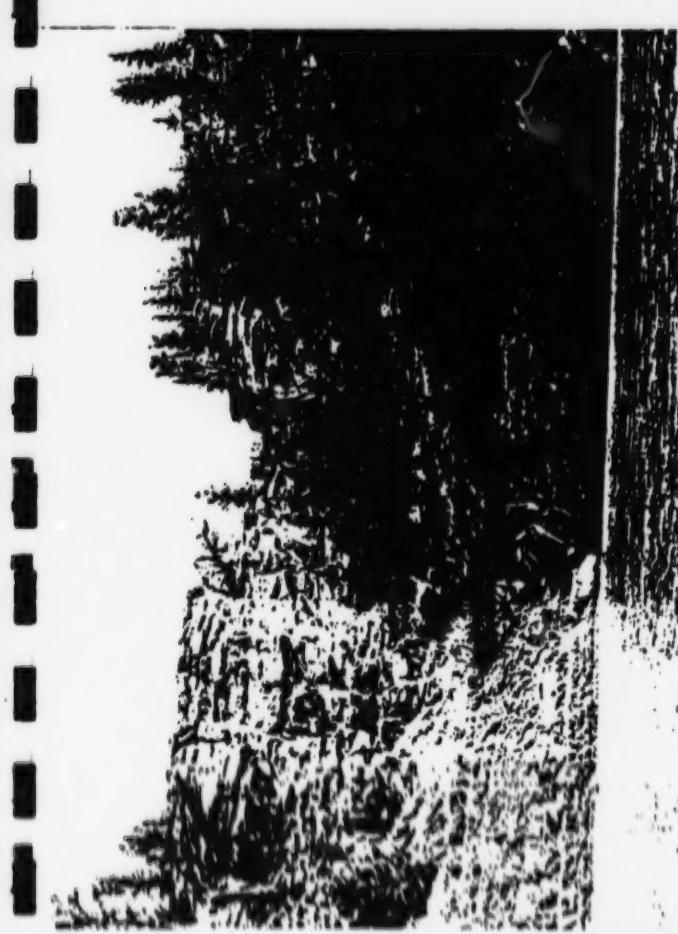
dollar coin is 26mm in diameter and the marker is 16cm long.

Photograph 61: Looking to the northwest across the Castle River from locality 54 is this relatively small exposure of Porcupine Hills Formation. The beach below the Full Supply Level is heavily littered with eroded sediments and sandstone blocks. This section may correspond to locality 55C in the Carbex report.

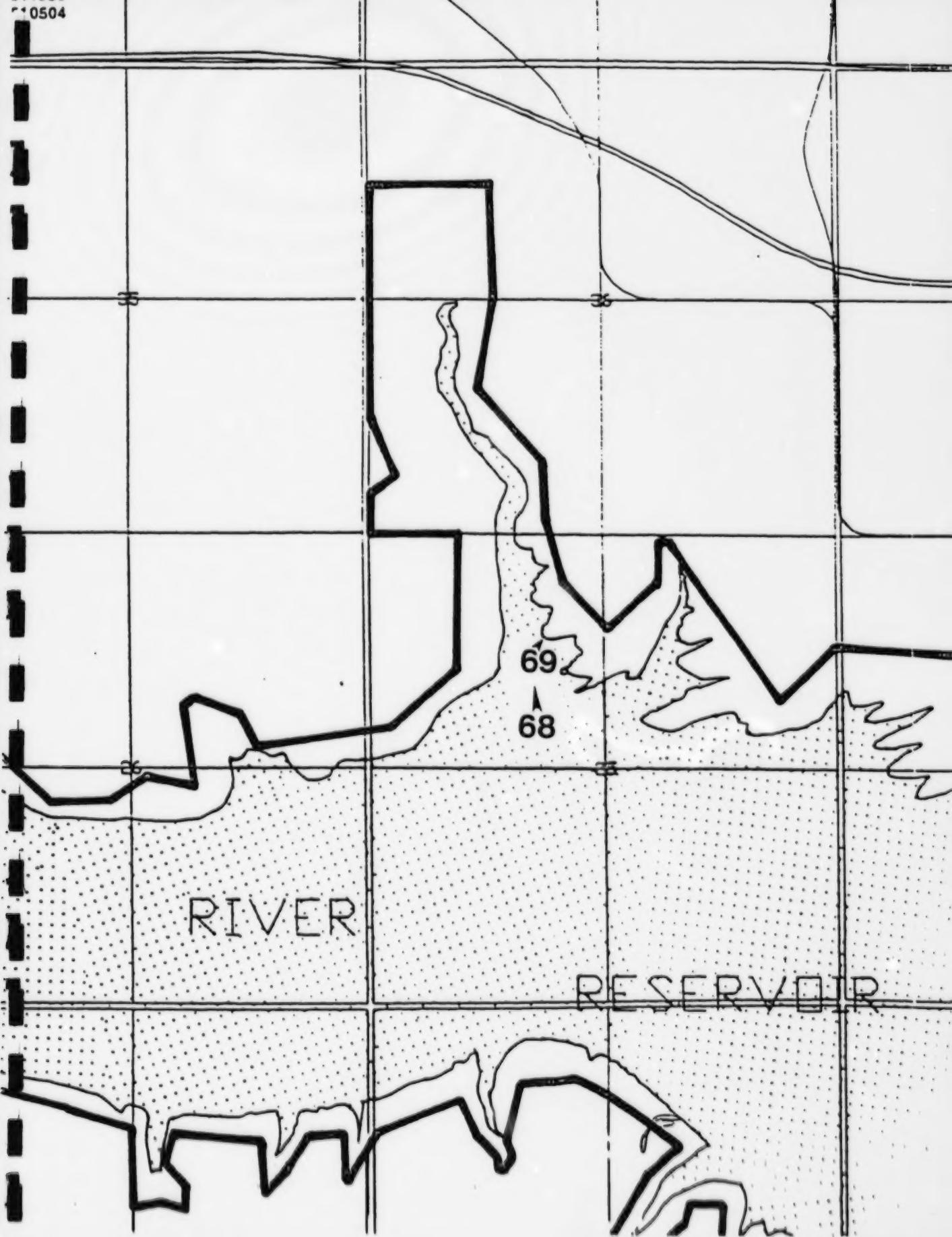
Photograph 62: Looking to the northeast at locality 55. Erosion of the lower half of this relatively steep face has changed its appearance over the past 9 years, the lower strata are now more clearly defined. Compare this photograph with C65 in the Carbex report. The upper sandstone unit corresponds to unit 10 in the Carbex study. The only fossils seen along this section were those of small molluscs preserved in a dark mudstone/siltstone just above the reservoir water level of 1110.96m. No samples were collected. The cliff is approximately 100m high.

Photograph 63: Looking to the northeast at, or very near to locality 55A. The prominent upper sandstone is the same as unit 10 in section 55. Although several massive sandstone blocks have fallen down onto the beach, I do not get the impression that erosion is rapid in this tiny backwater.

Photograph 64: Looking to the northwest at Treasureless Island, the Castle River, and the site of locality 58. The sandstone unit



MAP 8. The position and direction in which Photographs 68-69 were taken. A small "*" indicates where a field specimen (usually an organic or trace fossil) was photographed.



1 just above the water level is the same as unit 10 in section 55 and 55A. Carbonaceous smears are present in the sandstone. The upper-most surface of the sandstone is scoured as a result of glacial action.

Photograph 65: Looking to the northeast, close to locality 57 is this poorly exposed section of the Porcupine Hills Formation. Along this section of the Castle River, the exposures are limited due to plant cover. Some ripple marks were found at this locality but no fossils were discovered. The beach is heavily littered with eroded sediments, flagstones, and tree stumps.

Photograph 66: Looking eastward at locality 61, see also Carbex report photograph C73. Most of the lower third of the section consists of shales interbedded with thin sandstones. It is for the most part covered by dirt and cobbles derived from the vast Pleistocene tills forming the upper two thirds of this cliff. No fossils were found at this site. The vertical exposure and the unconsolidated nature of these sediments have resulted in extensive erosion. The Pogo stick is 1m long.

Photograph 67: Looking to the southwest along locality 62. The thick sandstone unit at and above water level probably corresponds to unit 10 at this locality in the Carbex report. Poor carbonaceous impressions of wood were observed at this locality. A clam block was collected from this locality in the scree along

the beach. Its unit of origin is unknown. Although some sandstone blocks have broken free, erosion of this unit appears minor to nil. Some of the cross-bedded sandstone layers which lie below the Full Supply Level appear to have been "swollen" apart when under water.

Photograph 68: Looking northward towards locality 67D. The massive sandstone units show no sign of rapid erosion. These sandstones lie below the Full Supply Level. Photograph 69 is a closeup view of the sandstone unit along the right hand side of this photograph. See also Carbex report photographs C90-C92.

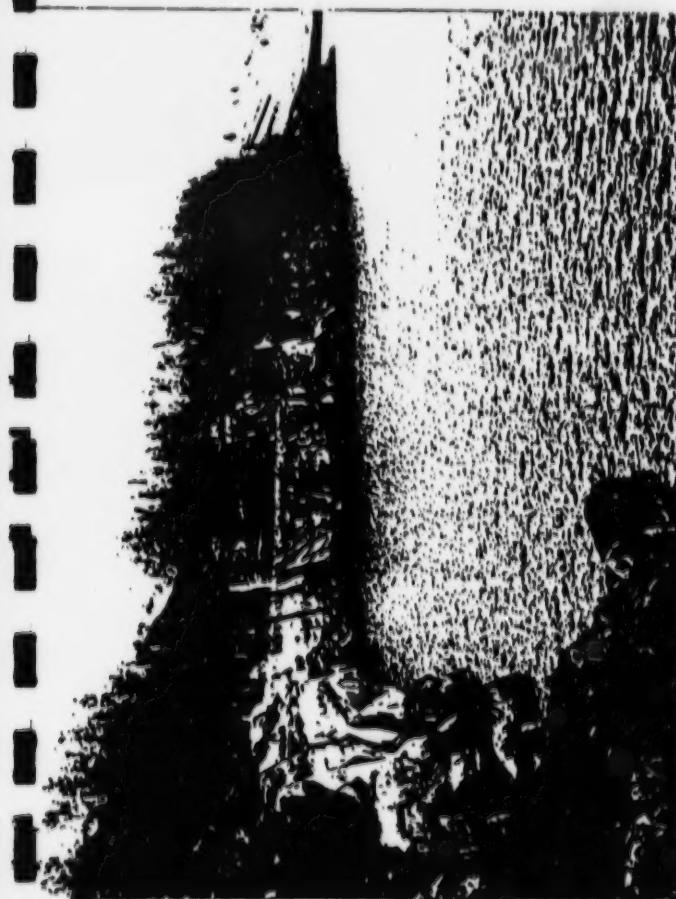
Photograph 69: Looking north at a thick sequence of water-eroded sandstone. The sandstones in this (these) unit(s) exhibit cross-bedding. Although these sandstones are not eroding rapidly, they are not immune to the effects of water carried abrasives. The Pogo stick is 1m long.

Photograph 70: Between locality 67A and 68, finger-like peninsulas along the northeast margin of the reservoir, consisting for the most part of unconsolidated Pleistocene tills, appear to be eroding rapidly. Wave and current action on these soft sediments would appear to be substantial. The Pogo stick is 1m long.

Photograph 71: South of locality 69, which is now under water, is this locality which consists almost entirely of Pleistocene tills. As the bank erodes, trees and other debris tumble down into the



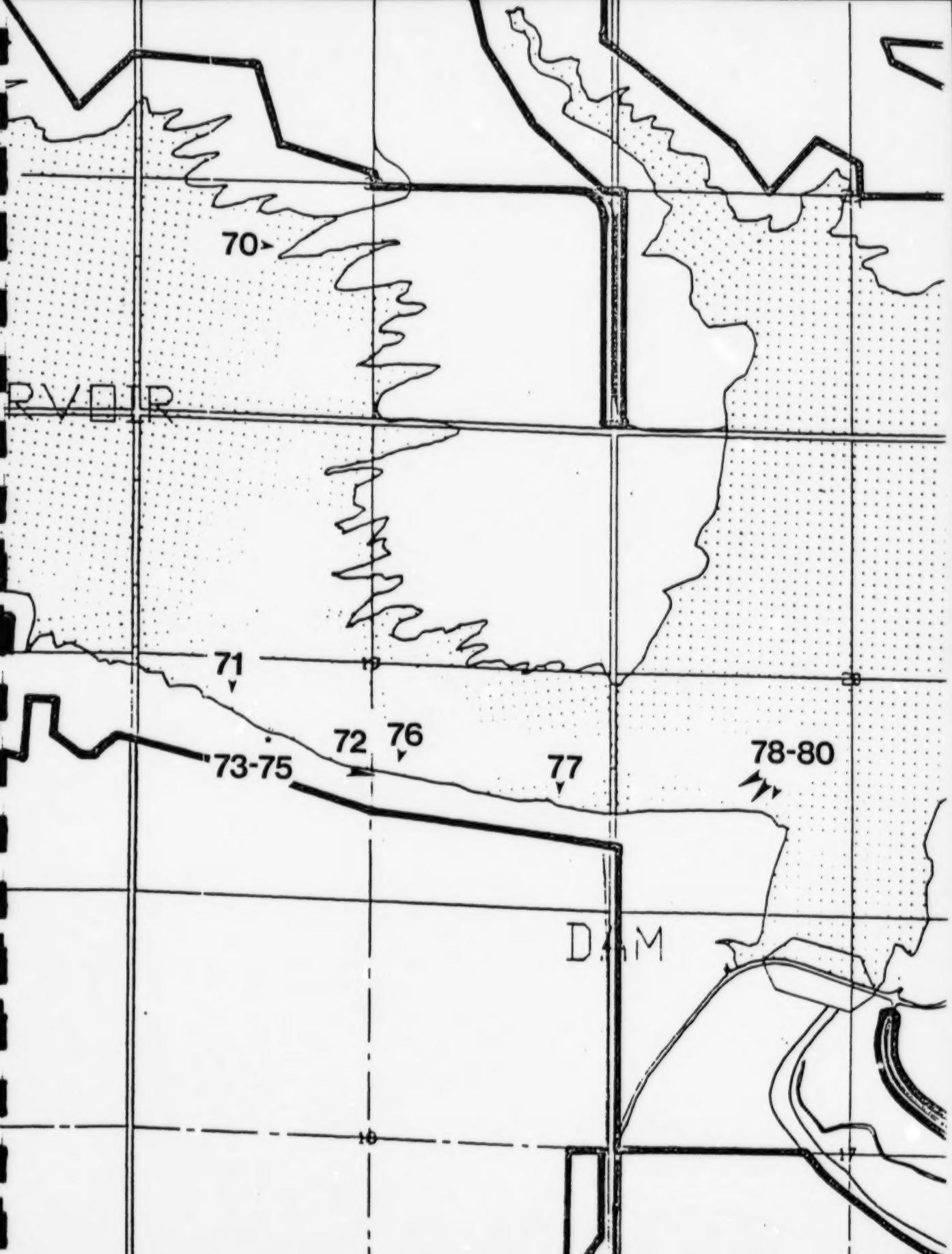
69



70



MAP 9. The position and direction in which Photographs 70-80 were taken. A small "*" indicates where a field specimen (usually an organic or trace fossil) was photographed.



reservoir.

Photograph 72: Looking eastward along locality 71. The south rim of the reservoir in this area is documented by photographs 71 through 80. Substantial quantities of Porcupine Hills Formation sandstone have fallen down onto the stump littered beach. These sandstones may be equivalent to those of unit 22 at locality 73, which is now under water. The Pogo stick is 1m long. Along this section of the reservoir, ripple marks (Photograph 74), trace fossils, bivalves and gastropods (Photograph 73) were found. The fossils are by no means abundant. Clean exposures are intermittent.

Photograph 73: Mollusc shells in a scree block. The lens cap is 56mm in diameter.

Photograph 74: Relatively large ripple marks occur in a sandstone just west of locality 71. This sandstone unit may be equivalent to those of unit 22 at locality 73 which also preserves ripple marks. The lens cap is 56mm in diameter and the Pogo stick is 1m long. See also Carbex report photograph C111.

Photograph 75: These in situ tree stumps near locality 71 illustrate to what extent soil and sediments have been removed since the initial flooding of the reservoir. I would estimate that sedimentary material to a depth of between 0.5m to 1m has been



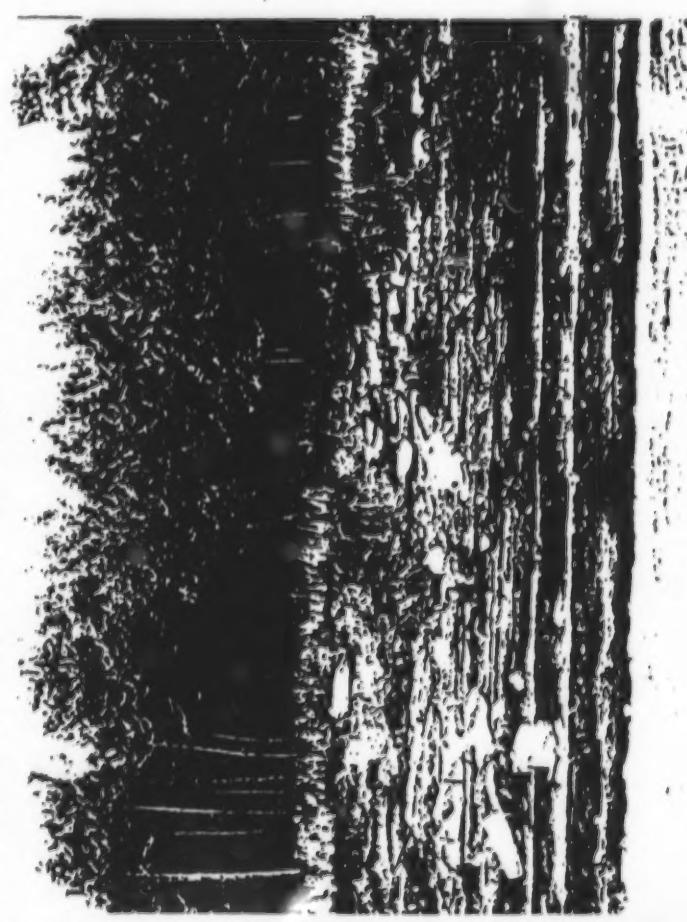
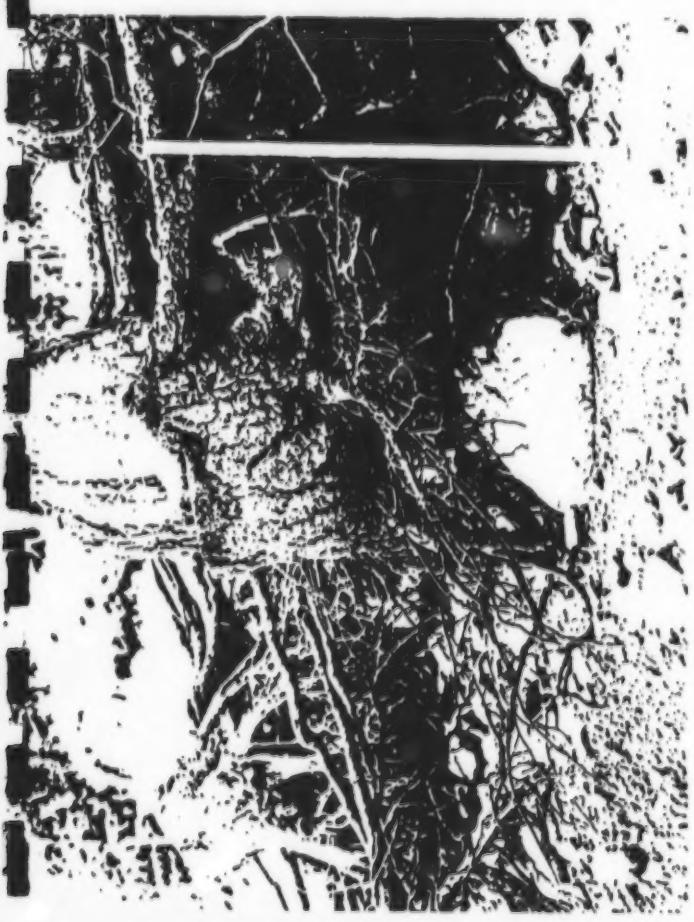
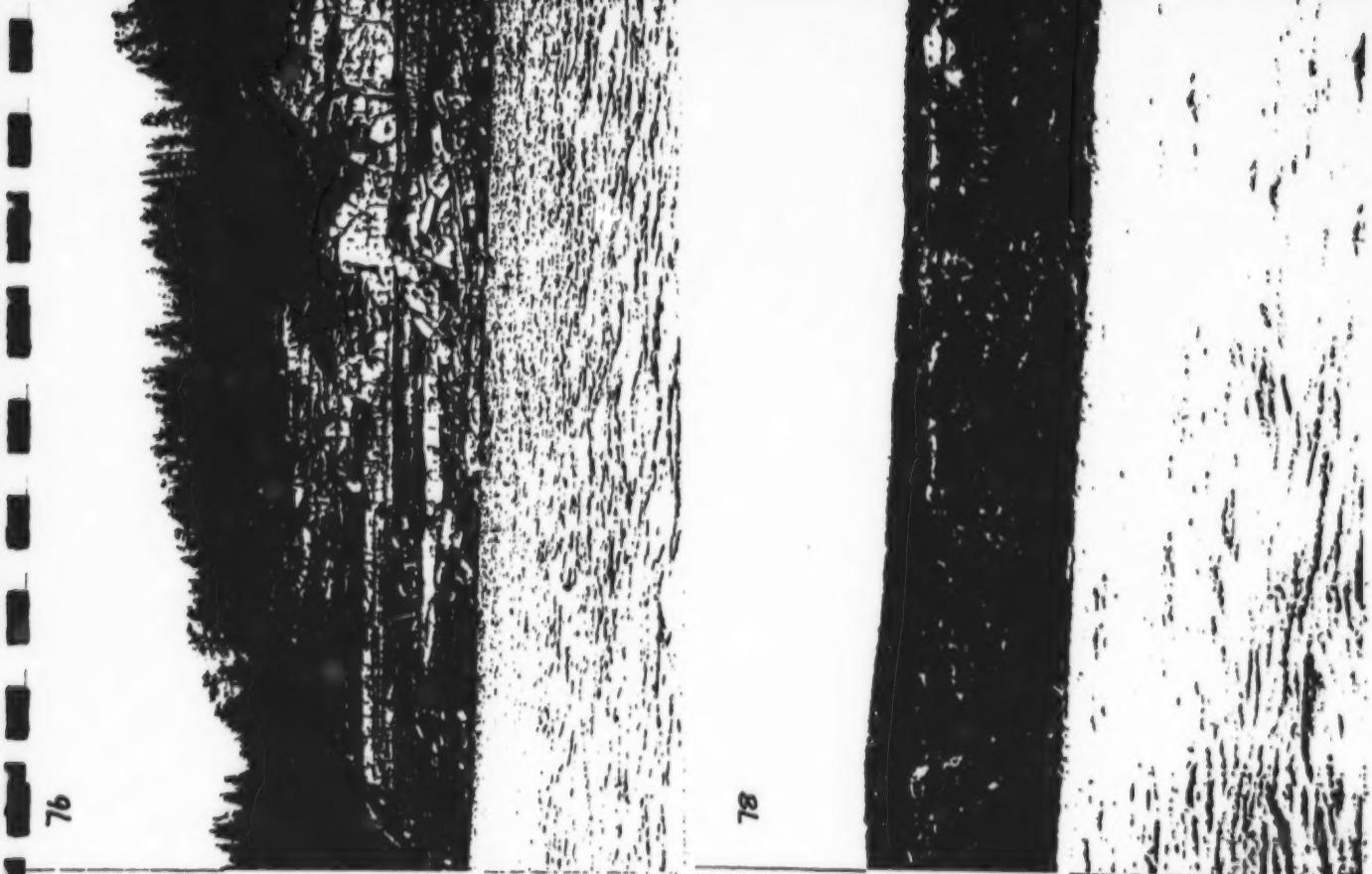
removed from this beach. The Pogo stick is 1m long.

Photograph 76: Looking south at or near locality 71. Note the prominent cliff forming upper sandstone, probably equivalent to the sandstones of unit 22 at locality 73. Some slumping of the sandstone is evident at this locality, note the centre of the photograph.

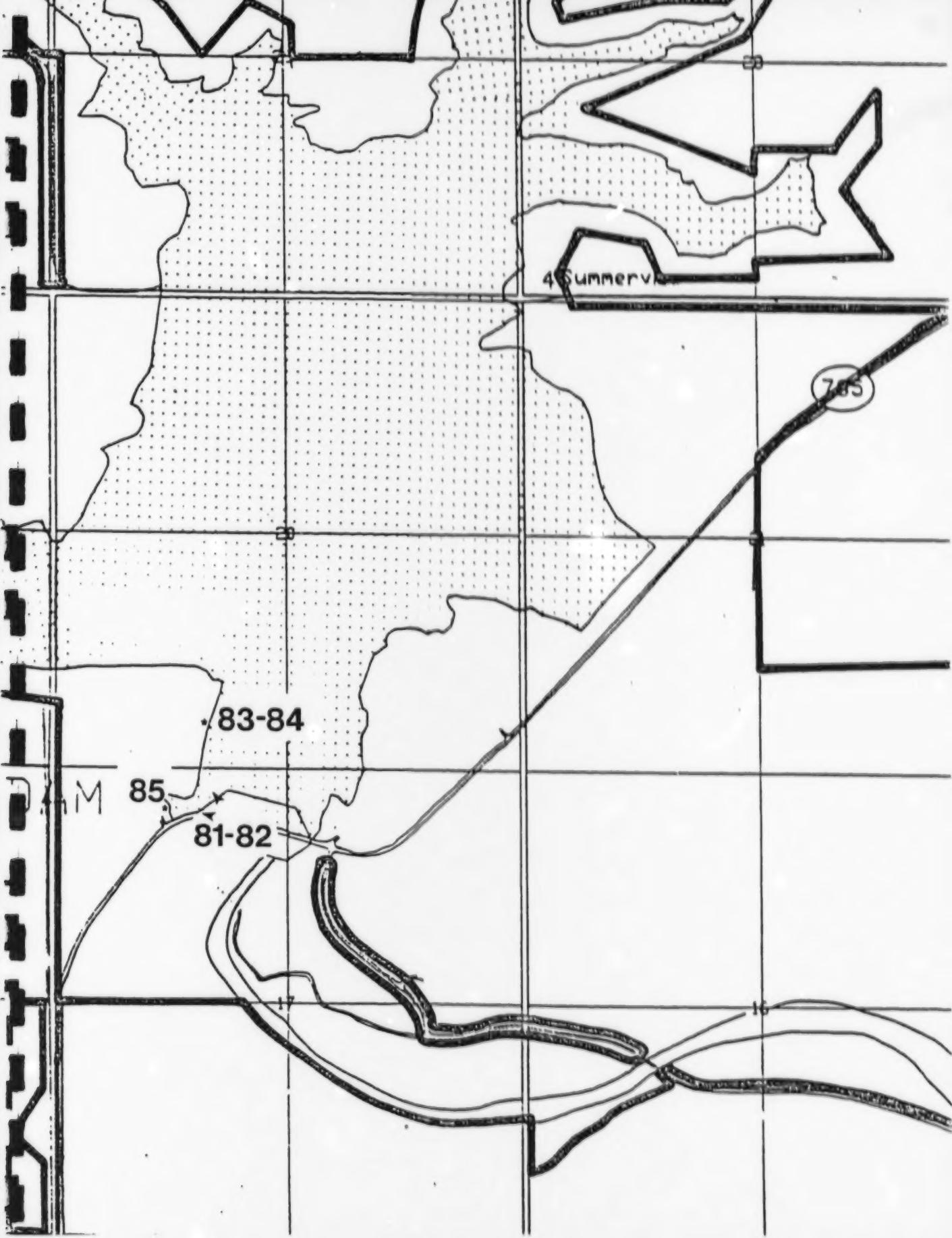
Photograph 77: Looking south at a locality just to the east of locality 71. The volume of eroded sedimentary material on the beach is significant and obscures most of the underlying Tertiary Porcupine Hills Formation.

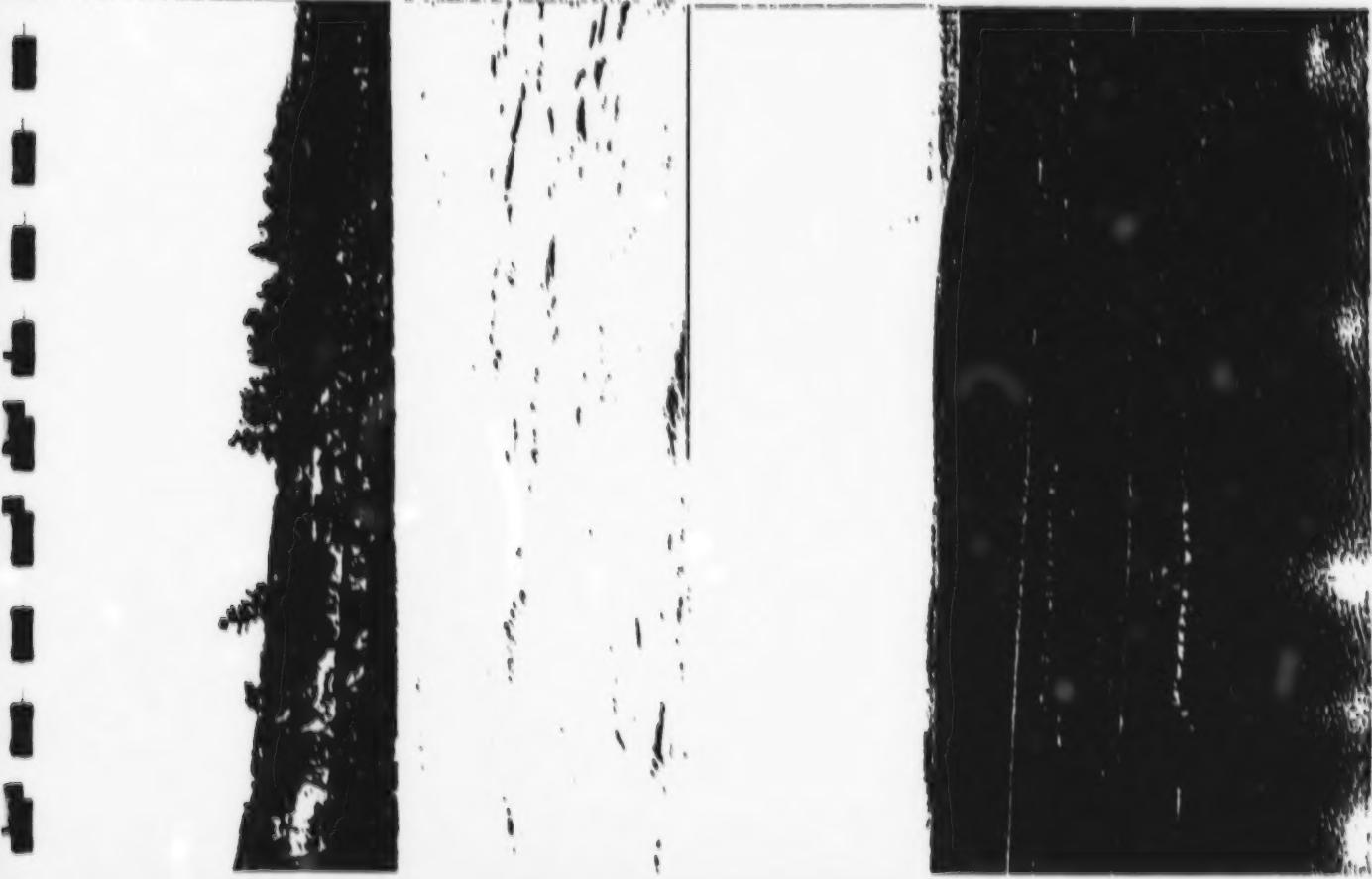
Photographs 78, 79, and 80: These three photographs taken together give a panoramic view of the south rim of the reservoir near locality 71. The cliff forming sandstone along the top of the outcrop may equate to unit 22 at locality 73. Undercutting, slumping, and breakage of the sandstones in this unit are significant. In Photographs 79 and 80, the Full Supply Level is marked by the line along the beach below which living trees do not occur. In Photograph 78, the Full Supply Level reaches nearly to the top of the bank.

Photographs 81 and 82: Looking westward and to the northwest at the nearly horizontal bedding of Porcupine Hills Formation strata along the access to the spillway. Rising water levels may cause



MAP 10. The position and direction in which Photographs 81-85 were taken. A small "*" indicates where a field specimen (usually an organic or trace fossil) was photographed.

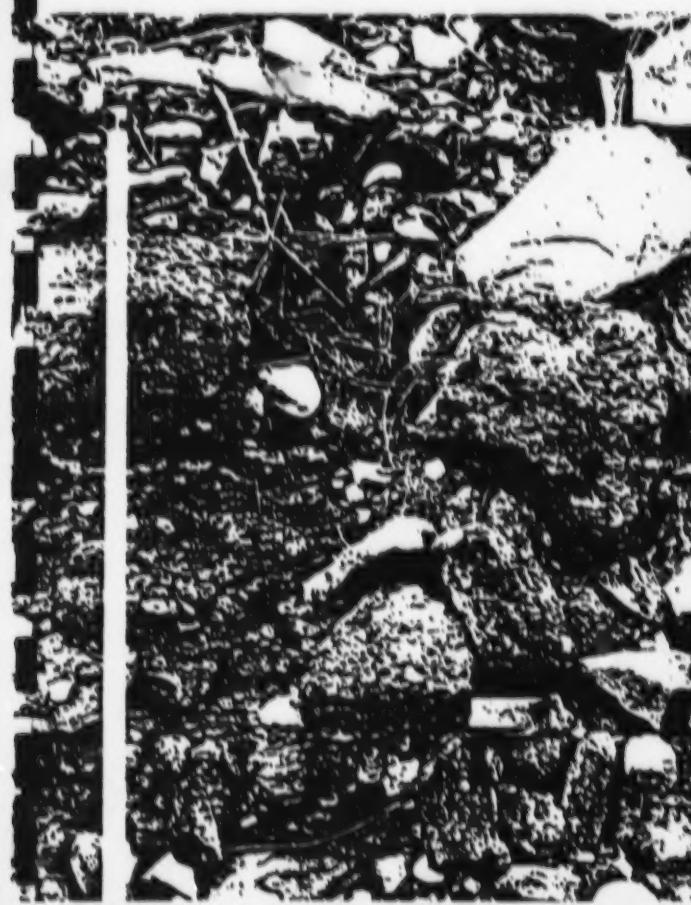




the sediments to swell and increase the rate of sedimentary decomposition. Most of the strata are composed of relatively soft and crumbly shales and other fine-grained sedimentary "rock". Along this section, some plant impressions were observed, but the rock was so badly fractured and crumbly that collection was impossible. Photograph 85 gives a good view of the friable nature of the fine-grain sediments in this area. Mollusc shells were found just below the sandstone lens seen to pinch out below the mini van in Photograph 81. Carbonaceous plant fragments were abundant in one unit lying between the lower mollusc layer and the road level. Furthermore, a piece of amber was collected from this area as well. On the west side of the spillway, to the immediate north of the warning sign post seen in Photograph 82 is a very coarse-grained sandstone, conglomerate-like, which also preserves bivalve shells (Photographs 83 and 84).

Photographs 83 and 84: Two views of a reddish conglomerate-like and very coarse sandstone which also preserves large bivalves (?unionids) and gastropod shells. These shells are located along the west side of the spillway just beyond the warning billboard and immediately below prairie level. The vertical axis corresponds to the long axis of the photograph in Photograph 83. In Photograph 84, the horizontal axis parallels the long axis of the photograph. The Pogo Stick is 1m long, and the lens cap is 56mm in diameter.

Photograph 85: This vertical burrow was photographed and then



collected. The vertical axis corresponds to the long axis of the photograph. It was discovered immediately below the upper sandstone unit above the access road along the west side of the spillway. The burrow is seen to pass from the sandstone unit down into the darker fine-grained ?shales. Sometime after the burrow was completed, it was infilled by the sandstone which now covers the crumbly shale. The lens cap is 56mm in diameter.

CONCLUSIONS AND RECOMMENDATIONS:

With respect to the palaeontological resources: Not a single bone was recovered from any of the Cretaceous or Tertiary formations exposed around or within the Oldman River Reservoir. However, the discovery of three sites from which good leaf impressions were collected would justify follow-up visits. I recommend that these leaf localities be revisited on a regular, perhaps annual basis, and that the entire reservoir be prospected again within five years. The rate at which sediments are being removed from the exposures justifies this recommendation.

This was my first visit to the Oldman River Reservoir. Therefore, I did not have any idea as to the rate of erosion to be expected. I would have to say that throughout this study, I was surprised at how soft the shales were and at the apparent rate at which many of the bedrock and Pleistocene tills were being eroded down into the reservoir. Although the indurated sandstones appear to be resisting erosion well, the ubiquitous shales are decomposing at a much faster rate. The harder sandstones are not immune to the effects of erosion however. As water undermines the sandstones, (by removing the shales), they too break into smaller blocks which then tumble down onto the beaches or into the reservoir. Comparing the texture of the sections now exposed to water and wave action, with those in the original 1987 Carbex report, shows that the softer Cretaceous and Tertiary shales are being eroded at a significant rate. Most of these shale units are highly fractured,

and crumble easily. The Pleistocene tills exposed along many high sections appear to be moving or slumping down into the reservoir at an even faster rate. I hasten to add however that on the basis of this single study, I am unable to quantify the rate of sedimentary erosion and accumulation within the main body of the reservoir. I do believe that it is occurring at a significant rate. I can not estimate how this sedimentary accumulation will shorten the half life of the reservoir. I would recommend further study, in an attempt to quantify the rate of sedimentary accumulation within the reservoir.